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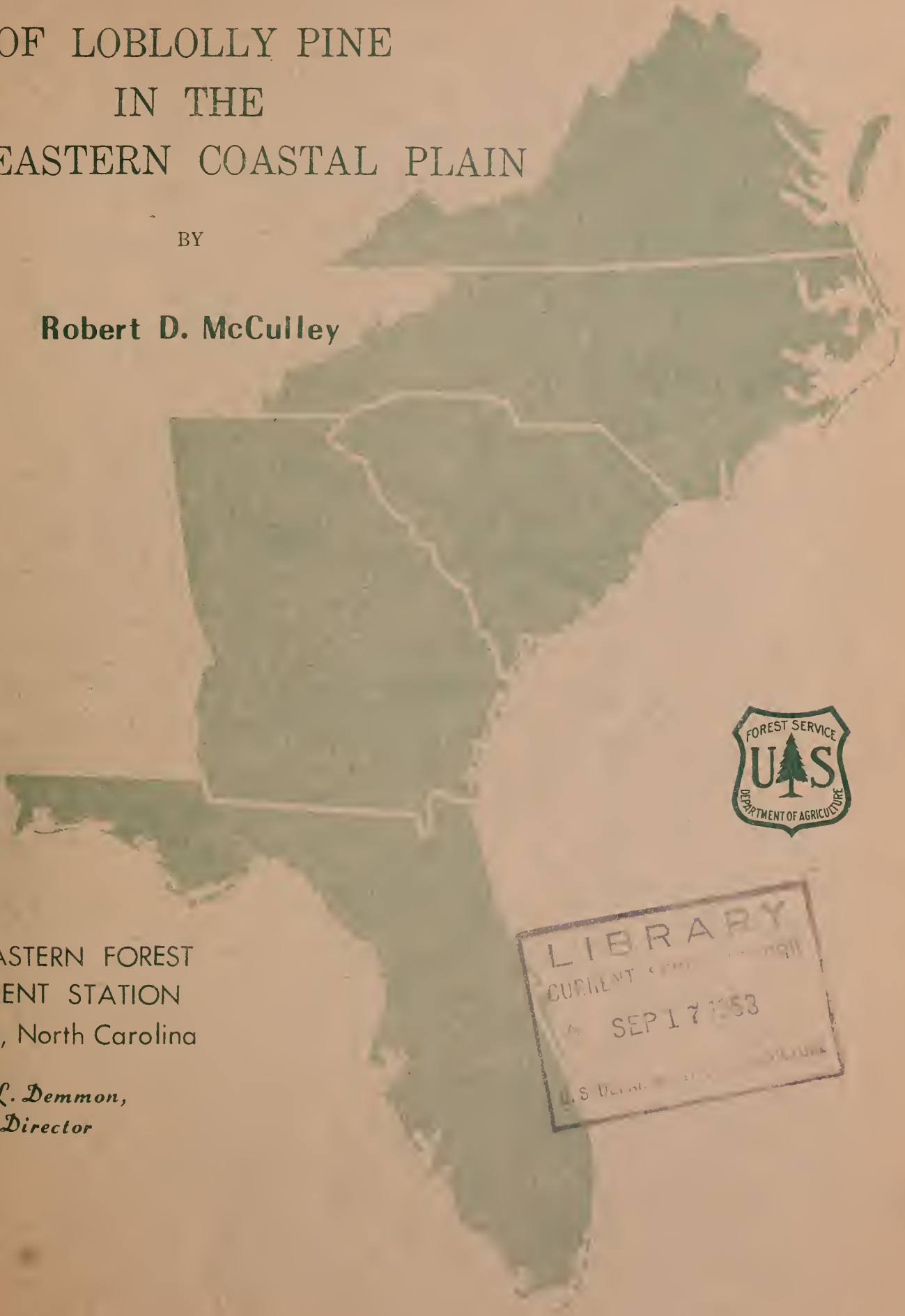
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BY

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NATURAL REGENERATION OF LOBLOLLY PINE IN THE SOUTHEASTERN COASTAL PLAIN

By

Robert D. McCulley

Loblolly pine timber makes up the largest part of the southern softwood timber supply. Within its range from New Jersey to Texas this species is the source of raw material for most of wood-using industry, and after harvest much of the land from which these trees are cut is left in need of reproduction to maintain a continuously productive forest. When these areas fail to seed in promptly to pine they aggravate the hardwood problem. They reduce future yields where an insufficient stand of reproduction develops. Dollar-wise these failures and partial failures represent an annual loss which conservative figuring places in the millions. Therefore, successful bridging of the gap between harvest of the old and establishment of the new stand is big business and worthy of concentrated attention from foresters and landowners alike.

The obvious remedy is planting. However, practical considerations limit planting to a partial solution at best. Of immediate importance is the time required to build up nursery capacity for such a tremendous undertaking. A serious obstacle is the reluctance of many landowners to invest in planting when examples of successful natural seeding are common. Taking into consideration these factors and others, a realistic appraisal must reach the conclusion that both planting and natural seeding will be used to reproduce cutovers in loblolly pine, and that we need to know how to handle both successfully. The purpose of this paper is to summarize some of the recent research in the Southeast which can contribute to the successful use of natural seeding. Details regarding most of the practices mentioned can be obtained from publications listed in the bibliography.

SEEDING CHARACTERISTICS OF LOBLOLLY PINE

The seed supply is of first importance in reproduction cutting because insufficient seed is certain to produce failure. The required amount varies tremendously from place to place, depending on the condition of the surface on which the seed falls. But where this seedbed is favorable and where losses from birds and rodents have not been large, a minimum of 25,000 sound seeds per acre has been required to produce a satisfactory stand of seedlings. The seedbed conditions on many tracts after logging will push this requirement up to 50,000 sound seeds or more.

In good seed years a mature stand will furnish this much seed and often several times this much. A 70-year-old unthinned sawtimber stand in North Carolina produced 260,000 sound seeds per acre in 1936, and a 90-year-old unthinned stand in the same state equalled this production in 1947. However, poor seed years are about as likely to occur as good ones, and in poor years the stands noted above produced 13,000 and 28,000 sound seeds per acre. Size and condition of the timber were ideal for seed production in these tracts. A more typical 50-year-old sawtimber stand in coastal Virginia produced 20,000 sound seeds in 1951, which was rated as a good year in that locality. It can easily be seen, therefore, that because of the class of timber or the general level of cone crop, years are common in which four, six, or eight seed trees will produce less seed than is needed and entire stands just reaching sawtimber size will often fail to do so.

Because seed is commonly the critical item in regeneration, characteristics of individual trees which indicate large seed-bearing capacity may provide valuable guides to marking practice. The best evidence of a tree's ability to produce seed has been found to be the presence of old cones in the crown -- the more old cones the greater assurance of fruitfulness. Cones of loblolly pine remain on the tree for as long as 3 years after they open, thus providing a key to productivity even when the current crop is poor. Another useful but less reliable indicator of the capacity to produce cones is trunk diameter. Trees 14 inches in diameter or larger which have old cones in the crown are the major seed producers and may be selected as seed trees. If seed is to be obtained from strips or blocks of uncut timber or from a heavy residual stand as in selection cutting, recognition of the fruitfulness of individual trees is not such a critical factor as when seed trees must be chosen. However, familiarity with characteristics of desirable cone-bearers is usually helpful when timber is marked for any type of reproduction cutting.

The usual time of seedfall and related matters often have a bearing on forest practice, particularly on the timing of seedbed preparation. Loblolly cones open on the trees in the latter half of October or first part of November, depending on the weather and the latitude where they develop. A general rule for flight of pine seed--that the effective seeding distance is within twice the height of the seed tree--seems to apply very well to loblolly. Most of the seeds fall shortly after the cones first open, and by the end of December only about 15 percent are left. These continue to be released through the winter and early spring. Therefore, practically all the seed from the stand is on the ground for several months before germination begins.

SEEDBED REQUIREMENTS

Next in importance to an adequate supply of seed is a favorable surface on which the seed can germinate. Mineral soil has been found to

be the best seedbed for loblolly pine in a number of special studies. A check of this conclusion on several hundred acres of cutover areas in the Bigwoods Experimental Forest[1/] showed that 9 seeds produced a seedling the first year where the litter had been disturbed and that over 40 were required on undisturbed areas or slash piles. Where the litter and slash had been burned off before seedfall, 15 seeds were needed to produce a seedling. The condition of the seedbed is therefore indicated quite readily by the proportion of the surface which has been disturbed to mineral soil. Fifty percent disturbance, well distributed, has permitted satisfactory stocking of reproduction on the cutting blocks sampled.

Some tracts will not be scarified enough through skidding, either because the volume to be removed is small or because the logs are lifted off the ground. Other areas will have such a poor seed source that efficient use must be made of all that is available. Various means of improving the seedbed on these tracts are being used effectively under a variety of conditions. These are combined operations in which the competition from inferior species is reduced at the same time the surface of the soil is disturbed.

Where competing stems are small (under 6 inches in diameter) a crawler tractor pulling a bush-and-bog disk harrow can cover an acre per hour of operation as a prelogging treatment (fig. 1). The same equipment



Figure 1.--Scarification before logging to improve seedbed conditions and reduce competition. A stump is dragged behind the disk to increase disturbance of the litter and root mat.

1/ Maintained by the Southeastern Forest Experiment Station in cooperation with Camp Manufacturing Company, Inc., Franklin, Va.

is not so effective after logging because the stumps may hang up the tractor or break disks, and slash concentrations must be avoided. Where larger competing stems are abundant, especially on areas which several years before failed to reproduce successfully, a bulldozer has been used to clear about half an acre per hour (fig. 2). Stumps offer less trouble for this machine after logging. Techniques for the use of fire in the coastal plain have been developed for application both before and after logging but its use is restricted to localities in which weather, fuel types, method of management, distribution of ownership, and public policy are relatively favorable. Under the proper circumstances fire has been cheap and effective. Regardless of whether seedbed preparation consists of burning, disking, or bulldozing, it must be done before seedfall lest the treatment destroy or bury the seed (fig. 3). Winter logging also probably destroys some of the seed on the ground, but the extra supply from the whole stand more than makes up for this loss.

COORDINATING SEED SUPPLY WITH SEEDBED CONDITION

Successful regeneration is dependent to a large extent on occurrence of adequate seeding when the seedbed is right. If seed comes a year late, rapid deterioration of the seedbed may reduce its effectiveness. In coastal North Carolina disturbed seedbeds between one and two years old have produced only a third as many seedlings from a given amount of seed as those less than 1 year old. Only one-tenth as many seedlings were produced on areas scarified 2 years before they were seeded. Competitive sprout growth adds to the difficulty of establishing reproduction after the first seedfall has gone by. Therefore, practical methods of bringing together a good cone crop and a favorable seedbed should be effective aids to successful reproduction cutting.

Use of Cone Crop Forecasts

Advance notice of the size of the next cone crop can be used under some circumstances to produce a favorable combination of seed supply and seedbed conditions. Cone crop estimates are being obtained long before seedfall by many of the state forest tree nurseries as part of their cone collection activities. In each of the past 2 years the North Carolina and Virginia State Forest Services have cooperated in making a cone crop forecast for the coastal plain a year before the cones were due to ripen, by counting conelets on samples from trees cut on logging operations. Others may be obtaining similar information. Although wide dissemination of these predictions has not been practiced in the past because the reliability of methods was under test, interested landowners can count on better guides to the size of future seed crops as more experience is gained in the use of forecast methods.



Figure 2.--Ideal seedbed conditions produced by bulldozer.

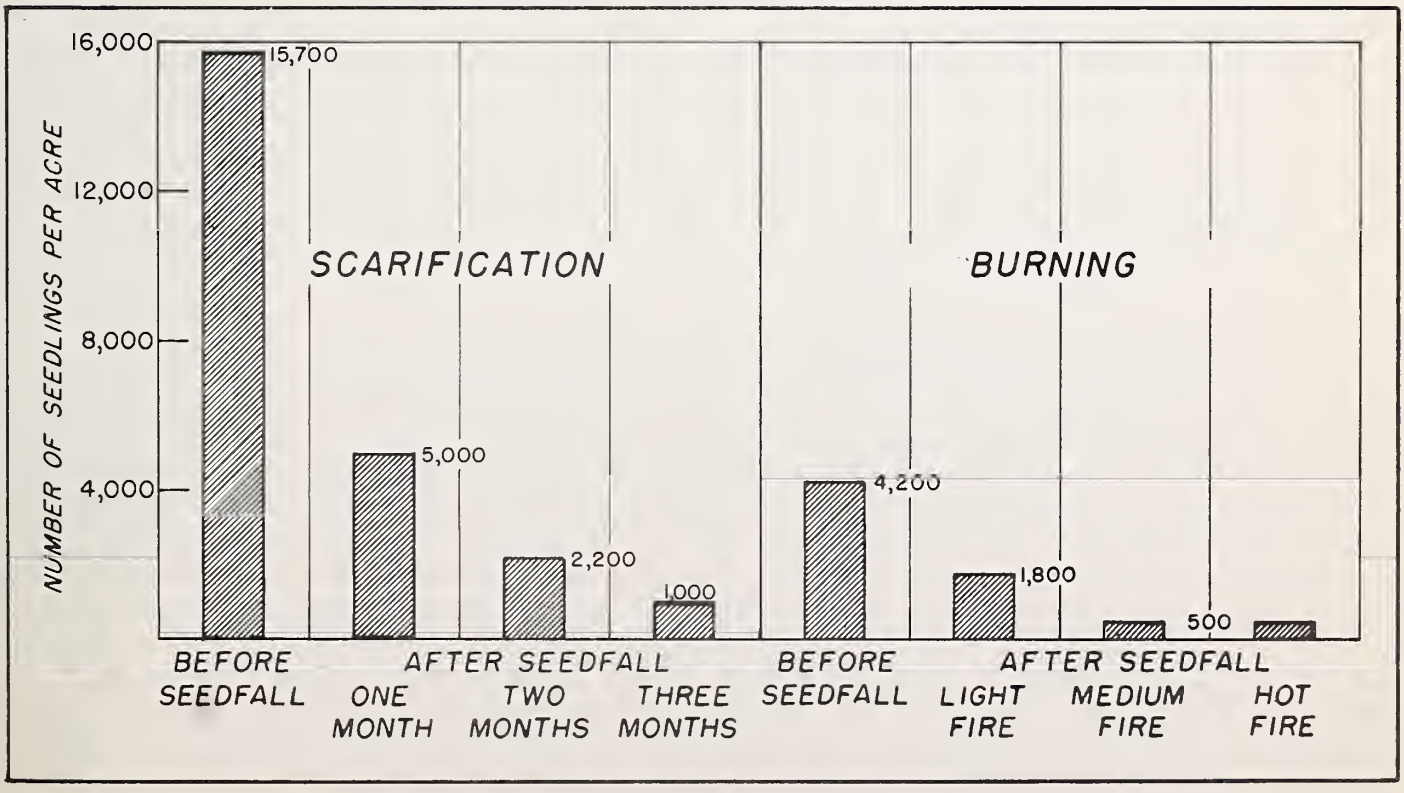


Figure 3.--Effect on seedling establishment of time of scarification and intensity of burn in relation to seedfall. Data on burning are from Chaiken (1).

The use of this information may be found essential to successful seedbed preparation in some localities. It may also influence cutting schedules. In fact, some landowners now plan to cut only when a good cone crop is in prospect. There is no better solution to the problem of seed supply on tracts having poorly stocked stands of pine where there is severe brush or hardwood competition. However, all cutting can't be scheduled for good seed years, because industry needs wood every year and at all seasons and a large part of it must come from reproduction cuttings. Advance notice of the size of the next seed crop is often useful but should be considered only one of several aids to more successful reproduction cutting.

Stimulating Seed Production Through Release

Planned cutting in a good seed year will increase the chances for successful reproduction on some of our forested acreage. On most of the rest, means must be used to obtain better seed supplies than will occur naturally. Research with a number of species has indicated that injury to the bole or applications of fertilizer may be practical ways of doing this, and limited trials have shown some promise for the success of these treatments on loblolly pine. However, the results obtained with these methods have been so overshadowed by the results obtained from crown release that crown release must be considered by far the best possibility for immediate practical application.

The fact that loblolly and other pines build up cone production after they have been isolated by cutting is not a new discovery at all. References to this reaction are common in the literature. The increase in number of cones produced has been attributed to a build-up of crown size and perhaps stored food reserves over relatively long periods such as 5 or 10 years. Observations during the past 5 years, however, have shown that the relationship between treatment and increased cone production is much more direct, is not based primarily on greater crown size, and will operate in generally poor seed years as well as in good ones (table 1). These facts can be of tremendous importance in the development of more reliable methods of reproduction cutting.

Release has caused as much as twenty times normal seed production on large overmature seed trees. It has doubled production on trees of minimum cone-bearing size in a generally poor seed year. Its effects have been observed on loblolly pine in Virginia, North Carolina, South Carolina, and Georgia, on longleaf pine in Alabama, and perhaps elsewhere within the range of loblolly. No instance is known in which release has failed to increase loblolly pine cone production and increase it substantially in the first crop year that could be affected. Also, the effects last more than 1 year; certainly for 2 years at a maximum level, and probably for a third year at a lower level. These observations justify the conclusion that release of crowns is capable of providing enough extra seed to permit successful reproduction cutting in a generally poor seed year, and that the effects last long enough to allow considerable flexibility in cutting plans which include preharvest release as part of the regeneration cycle.

Table 1.--Indexes of seed production from uncut stands in the Bigwoods Experimental Forest compared with those for released seed sources, using a bumper crop (1947) as the base for comparison

Year	Total seed yield 1/			
	Unreleased stands		Released sources 2/	
	#1	#2	#3	#4
	Indexes			
1947	100	100	3/ 100	3/ 100
1948	17	17	110	106
1949	14	11	137	131
1950	42	54	168	73
1951	66	65	238	
1952	29	50	196	245

1/ Includes those empty and damaged seed which fell from cones.
2/ One fourth of stand in leave strips or scattered seed trees -- 8 per acre.
3/ Unreleased 1947 production as base.

One characteristic of southern pine cone formation must be kept in mind when any method of stimulating seed production is under consideration. More than 2 years are required for a loblolly pine cone to mature, so the response to any stimulus is certain not to affect the number of cones in the succeeding two cone crops (fig. 4). Stands partially cut during the growing season therefore show the effect of release in the third or fourth crop after cutting, depending on whether release came early or late in the season (fig. 5). The critical period seems to occur in late June or early July, probably varying somewhat from year to year. It is safe to count on an increase in the third succeeding cone crop if the trees are released before the end of May.

The exact amount of release required has not been determined. In the one closely controlled study which has been completed, the space cleared around each released tree was equal to $2\frac{1}{2}$ to 3 times its crown width, producing a cleared area averaging about 40 feet in diameter with the tree at the center. Less complete release provided by a general improvement cut has

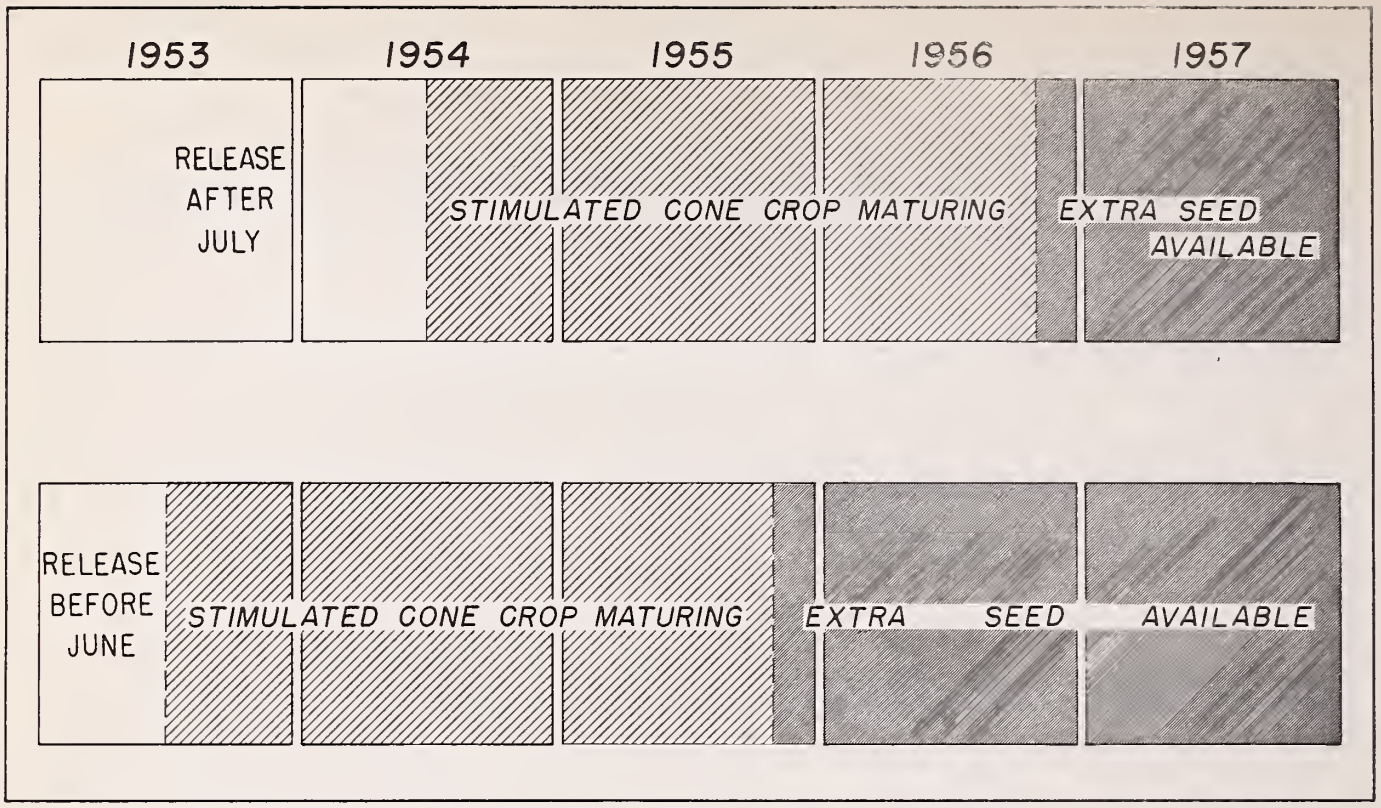


Figure 4.--Release before June, as compared with release after July, brings a stimulated seed crop one year earlier.



Figure 5.--Two conelets as they appear in April a year and a half before they ripen. Release at this stage comes almost a year too late to influence the size of this cone crop.

been observed to stimulate many of the trees left. In practice, if individual trees are selected for release it is probably sufficient to cut enough competitors so there is a 10-foot space forcrown expansion on all sides (fig. 6). If release is planned through a general partial cut any method of cutting will probably be satisfactory which produces an operable sawtimber volume.



Figure 6.--Seed tree released three growing seasons before removal of the stand. A, crown free on all sides. B, cleared area around base where cut averaged 550 board feet per released tree.



USE OF CONTROLLED REGENERATION IN PRACTICAL MANAGEMENT

The use that can be made in practical management of available information about seed supplies and seedbed requirements will be influenced to some extent by the type of silviculture used. Where selection management is the established policy, variability in the seed supply may be readily overcome by cutting on a short enough cycle so that freshly disturbed seedbed is produced in the openings in the same years that seed production is stimulated on surrounding trees. A 5-year cutting cycle should be fairly effective but a 4-year cycle would be better. Scarification of failed spots with heavy equipment seems possible in this type of forest but not the use of fire.

The number and size of trees to leave in cuttings of the seed-tree type has been under study for as long as this method of reproduction has been in use. Emphasis has usually been placed on determining the minimum which would give some assurance of providing seed. The value of the trees has been considered comparable to a planting cost to be carried as a charge against the reproduction, although there was hope that they could be salvaged later on. More precise information about seed and seedbed requirements has shown the value of additional seed trees to give greater assurance of adequate seeding. The rapid decrease in their effectiveness through seedbed deterioration has also suggested their prompt removal after reproduction is established. Instead of the minimum requirements most often thought of in the past, therefore, the most effective and economically sound approach probably is to plan for enough sawlog volume in seed trees to provide an operable cut after seedlings have been established. Eight, ten, or twelve trees to the acre can be left with this schedule of cutting in mind without considering them a financial loss and with greater assurance that they will provide enough seed for adequate stocking. If these trees are released by partial cutting 3 to 5 years before the final harvest, the combination of seed supply and seedbed thus provided is as nearly ideal as any known under the seed-tree system. Removal of the seed trees after seedlings are established will result in some damage to the young growth, but where the seedlings are 1 or 2 years old this can be confined to major tractor roads and loading areas. Trees can be felled toward or away from concentration points marked in advance, thus reducing damage to a minimum. Larger seedlings and saplings are more brittle and therefore more vulnerable. Possibility of drought losses during the first year's growth are so great that seedlings should be at least 1 year old before the seed trees are taken off.

Eight scattered seed trees have consistently produced more seed than one-fourth of the stand in leave strips where these types of cutting have been compared in North Carolina. Yet strip cutting where stands are uniform may be used for other reasons. Methods of stimulating seed production in the leave strips would be similar to the preharvest release of seed trees, and timing of the final cut the same.

During the first years after they are established, stands of loblolly pine seedlings are vulnerable to fire and may be completely wiped out. In the past, seed trees have provided some assurance that a disastrous fire would not leave a tract completely unproductive. This was not perfect

insurance by any means, because a poor seed year could easily coincide with the year of the fire. But in a time of low stumpage values as compared with planting costs, and in the days of commonly high fire risk, even partially effective insurance was essential. Now that stumpage values are higher and fire risks lower, the justification for leaving insurance trees is much less clear-cut.

The general principles regarding seed supplies and seedbed conditions which will reduce the uncertainty in reproduction cuttings of loblolly pine can be summarized as follows:

For all-aged management

1. Harvest on a short enough cycle so that seed production stimulated by release will still be effective at the time of each cut.

For even-aged management

1. Cut poorly stocked or depleted stands in years of generally heavy seed production.

2. Leave a relatively heavy seed-tree stand and plan to harvest it as soon as reproduction is well established.

3. Where stand conditions are suitable, stimulate the seed source through preharvest release 3 to 5 years before the reproduction cut.

4. If local policy and experience are favorable, use scarification equipment or fire where seed supplies are likely to be inadequate.

SEEDLING ESTABLISHMENT

The object of all plans for reproduction cutting is a well-stocked stand of seedlings which are free to grow. For most conditions of ownership this means about 750 seedlings per acre, well distributed, with no overhead competition. Some landowners will be satisfied with fewer seedlings and some will want more, but 750 is probably a fair average. However, initial establishment of several thousand seedlings per acre usually is required to reach this goal. Uneven distribution, losses from various causes, and competing vegetation all reduce the effectiveness of the total number first established.

By far the most common problem encountered is the competition from residual hardwoods and hardwood sprouts (fig. 7). The larger residuals reduce the effectiveness of the seedling stand through competition for light and moisture and also by acting as a physical barrier to normal height growth. They reduce the area available for production of pine by approximately the area under their crowns. It's not unusual for this reduction to

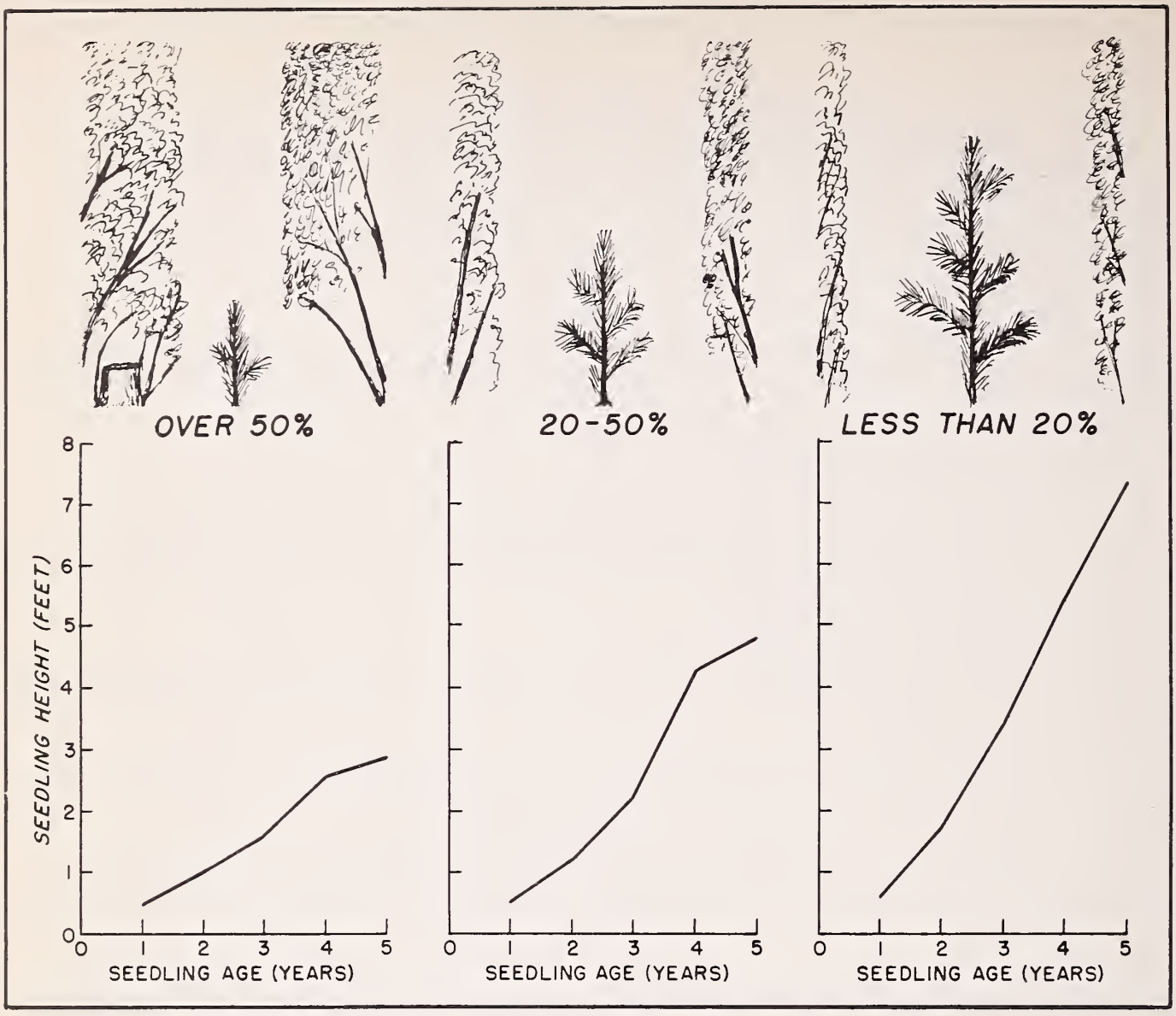


Figure 7.--Heights of loblolly pine seedlings 1 to 5 years old in the Bigwoods Experimental Forest growing under 3 conditions of overhead shade. Shade from competitors $\frac{1}{2}$-inch d.b.h. and larger classified on 0.01-acre plot immediately after harvest of pine stand--seedling measured was tallest found on central 0.001-acre plot at the end of each growing season.

be as much as a fourth of the growing space. Liberation of seedlings from these larger competing stems can be accomplished through girdling, or poisoning with 2-4-5,T or Ammate. Recovery of seedlings thus liberated has been rapid (fig. 8). Even those which have been suppressed for long periods quickly build up normal crowns and begin rapid height growth.

Smaller competing stems can be handled most effectively by methods which also prepare the seedbed. Logging itself may reduce the hardwood cover effectively in many instances. If there is no delay in their establishment, pine seedlings usually compete successfully with sprouts from hardwoods that are cut or broken off, or killed back to the ground. In general, sprouts from red maple and sweetgum are more serious competitors than those from the oaks. Usually by the end of their fifth year and often sooner the success or failure of pine seedlings in overcoming competition becomes obvious. Where help must be provided, it can be given by severence of competing stems or by treatments with chemicals.

CONCLUSION

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Forest managers who use the aids to successful reproduction cutting discussed in this paper will have to give a little more than average attention to thorough planning, careful supervision, and the details of intensive management. Heavy expense is not involved. Nevertheless, a period of trial is needed during which the results of more careful work accumulate to justify whatever extra costs there are. Numerous examples show that too little attention to the requirements for reproduction can lead to reduced yields and expensive rehabilitation projects. More examples of intensive practice are needed to emphasize the importance of keeping pine timberlands in good growing condition.

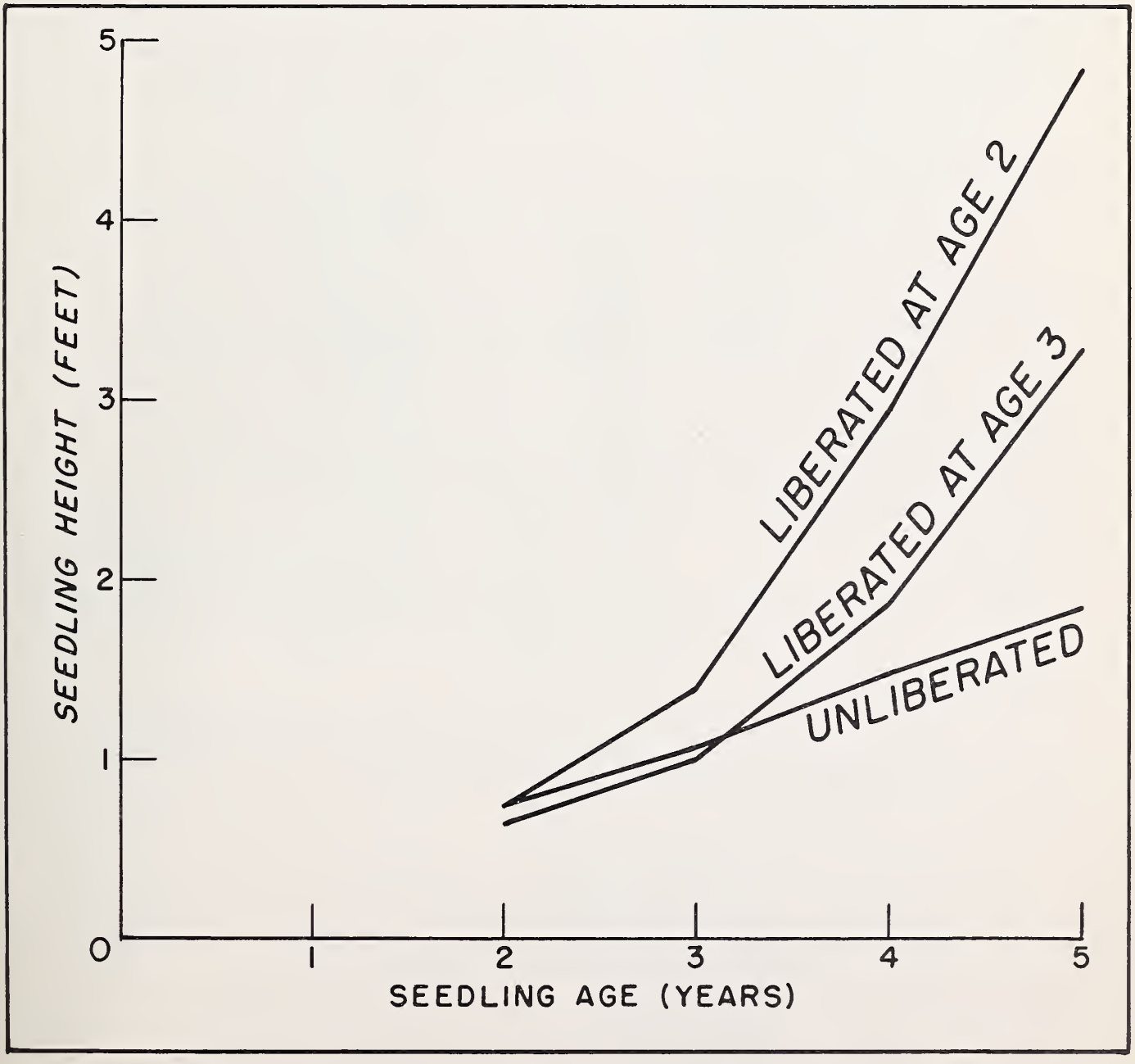


Figure 8.--Heights of seedlings 2 to 5 years old in the Bigwoods Experimental Forest with and without liberation from overstory hardwoods 4 inches and larger.

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BIBLIOGRAPHY

1. Chaiken, L. E.
1952 Extent of loss of loblolly pine seed in winter fires. Southeastern Forest Expt. Sta. Research Note 21.

2. Chaiken, L. E.
1951 The use of chemicals to control inferior trees in the management of loblolly pine. Southeastern Forest Expt. Sta., Station Paper 10.

3. Pomeroy, K. B.
1949 Loblolly pine seed trees: selection, fruitfulness, and mortality. Southeastern Forest Expt. Sta., Station Paper 5.

4. Trousdell, K. B.
1950 Forecasting loblolly pine cone crops. Southern Lumberman 183(2297): 137, 138.

5. Trousdell, K. B.
1950 Seed and seedbed requirements to regenerate loblolly pine. Southeastern Forest Expt. Sta., Station Paper 8.

6. Trousdell, K. B.
1953 Favorable initial seedbed conditions for loblolly pine disappear within 3 years. Submitted to Journal of Forestry for publication.

7. Wenger, Karl F.
1953 The stimulation of loblolly pine seed trees by preharvest release. Submitted to Journal of Forestry for publication.

8. Wenger, Karl F.
1953 The effect of fertilization and injury on the cone and seed production of loblolly pine seed trees. Submitted to Journal of Forestry for publication.

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